THE PRESENCE AND DISTRIBUTION OF SMALL CARNIVORES IN OIL PALM PLANTATION AND THEIR ROLE IN CONTROLLING RAT DAMAGE: PRELIMINARY RESULTS FROM A CAMERA TRAPPING STUDY

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ABSTRACT

The presence and distribution of small carnivores were investigated in two oil palm plantations using camera-traps. Eight camera-traps - four in Rama-Rama estate and four in Libo estate (Riau Province, Indonesia) - were set up in March 2012. Two cameras were located near a protected forest, three near a conservation area two in the centre of the oil palm plantation, and one near a settlement. The camera-traps were successful in photographing three small carnivore species (leopard cat, *Prionailurus bengalensis;* common palm civet, *Paradoxurus hermaphroditus*; Malay civet, *Viverra tangalunga*) and one reptile (monitor lizard, *Varanus salvator*), which are all predator of rats. Preliminary analyses suggest that the distribution of small carnivores and reptiles were affected by habitat features in the oil palm plantation, such as settlement and conservation areas. The camera traps set near the protected forest and conservation area photographed more frequently predators of rodents, suggesting that these areas may play an important role for small carnivores (such as providing daytime resting sites). In general, small carnivores were photographed as early as 18:00 – 19:00h (when they start to hunt and search for food) until 06:00 – 07:00h (when they return to their daytime rest site).

Over the past 15 years, the barn owl (*Tyto alba javanica*) has been propagated in oil palm plantations in Riau Province in order to control rat populations. The presence of small carnivores and the monitor lizard is complementary to the barn owl for maintaining rat damage below economic threshold, as indicated by a rat damage census for the last five years in Libo and Rama-Rama estates.

A preliminary finding of our study suggests that conservation areas in oil palm plantations may help promote the diversity of small carnivores and reptiles, which in turn will keep rat damage stable at a low level. This study has now been enlarged with 10 additional camera-traps, and a later full analysis of all the data may confirm the preliminary results presented here.

Key words*:* Rat damage, small carnivores, reptile, camera trap, oil palm plantation.

INTRODUCTION

Oil palm is one of the most rapidly increasing crops in the world. Oil palms are subject to attack by pests in the field, among which rats are one of the most destructive, causing problems

from nursery to mature areas (Wood and Chung, 2003). The numerous predators of rats include various species of cats, civets, owls, snakes, and monitor lizards (Wood, 1976). The barn owl, *Tyto alba javanica* has been intensively studied (Lenton, 1984; Smal, 1988; Naim *et al*., 2010; 2011), while other predators, such as civets and cats, are poorly known and there are only very few studies on these species, especially in oil palm plantation (see: Lim, 1974; 1999; Chung, 2000; Scott and Gemita, 2004; Rajaratnam *et al.,* 2007).

The use of camera-trapping for studying small carnivores in Indonesia and other Southeast Asian countries has become increasingly popular in recent years (Maddox *et al.,* 2007; Arlyne *et al.,* 2009; Jennings *et al*., 2010), as camera technology has improved and equipment costs have decreased (Tobler *et al.,* 2008). Applications of camera-traps range from species inventories to estimation of animal density and abundance (O'Connell *et al.,* 2011). Our study was initiated to investigate the presence and distribution of small carnivore species in oil palm plantation and the effect of habitat within and around oil palm plantation on small carnivore species. Here we present the preliminary results of the initial phase of the study.

MATERIAL AND METHOD

Location and period of the study

This study was conducted in two mature oil palm plantations: Libo estate and Rama-Rama estate in Riau Province, Indonesia, from March to November 2012. The terrain was flat to undulating. In Libo, the estate is a big block covering 4000 ha and surrounded by oil palm smallholders, large swamp had been protected as conservation area, mainly in the south of the estate. In Rama-rama, the landscape is more heterogeneous, the oil palm estate (4092 ha) is fragmented, with one forest reserve, riparian areas, acacia plantation and oil palm smallholders in the border.

Installation of Camera Traps

Eight passive camera traps (4 Reconyx and 4 Bushnell) were set up in the two estates: four in Libo and four in Rama-Rama (Table 1). Camera traps were tied to the trunks of palm trees at an average height of 30 cm above the ground, and 2-3 metres from a path. Two camera traps were set near the protected forest in Rama-Rama; three were set near a conservation area in Libo; two were set in the centre of the oil palm plantation, and one near a settlement. Cameras

were operating 24h a day and were checked for every 3-4 weeks to replace batteries and memory card, if necessary.

Table 1. Camera trap position, brands, effort and altitude

Estate	Site number	Position	Camera Brand	Trap nights	Altitude (m)
Libo	LI001	Near Conservation area	Reconyx	250	84
	LI002	Near Settlement	Reconyx	249	63
	LI003	Near Conservation area	Bushnell	238	51
	LI004	Near Conservation area	Bushnell	70	34
Rama-rama	RA001	Centre of oil palm estate	Bushnell	247	32
	RA002	Near Forest	Reconyx	247	22
	RA003	Centre of oil palm estate	Bushnell	246	46
	RA004	Near Forest	Reconyx	109	27

Data analysis

All images were downloaded and for every photograph, the station, date, time and the species were recorded. The catch per unit effort was calculated as the total number of independent captures divided by the total number of trap nights (Scott and Gemita, 2004). Occupancy rates were determined using PRESENCE 4.1 (MacKenzie *et al*., 2006), and detectability was calculated following the method developed by MacKenzie *et al.* (2006).

RESULT AND DISCUSSION

A total of three small carnivore species and one lizard species were photographed during this study: two small carnivores (leopard cat and common palm civet) and the monitor lizard in Libo estate; three small carnivores (leopard cat, common palm civet and Malay civet) and the monitor lizard in Rama-Rama estate (Table 2).

The diversity of small carnivore species observed so far is lower compared to the study of Maddox *et al*. (2007) in Jambi Province, where 19 species of carnivores were recorded. However, this study was conducted both in a forest and an adjacent oil palm plantation, and

showed that oil palm plantation support much fewer species than forest (see also Fitzherbert *et al.* 2008).

Table 2. Records and catch per unit effort of the three species of small carnivores and monitor lizard camera-trapped in Libo and Rama-Rama estates

Estate	Camera Trap	No. of Independent records				CPUE			
		Small Carnivores			Reptile	Small Carnivores			Reptile
		LC	PC	MC	ML	LC	PC	MC	ML
Libo	LI001	23	15	0	3	9,20	6,00	0,00	1,20
	LI002	9	3	0	0	3,61	1,20	0,00	0,00
	LI003	30	4	0	10	12,61	1,68	0,00	4,20
	LI004	36	1	0	0	51,43	1,43	0,00	0,00
	Total Libo	**36**	**1**	**0**	**0**	**12,14**	**2,85**	**0,00**	**1,61**
Rama-Rama	RA001	4	2	0	1	1,62	0,81	0,00	0,40
	RA002	31	0	1	0	12,60	0,00	0,41	0,00
	RA003	13	0	1	0	5,28	0,00	0,41	0,00
	RA004	27	1	0	1	10,98	0,41	0,00	0,41
	Total Rama-Rama	**75**	**3**	**2**	**2**	**7,61**	**0,30**	**0,20**	**0,20**

Remarks: CPUE= Catch Per Unit Effort, number of photographed for each animal per 100 trap nights.
LC= Leopard Cat (*Prionailurus bengalensis*); PC= Common Palm Civet (*Paradoxurus hermaphroditus*)
MC= Malay Civet (*Viverra tangalunga*); ML= Monitor Lizard (*Varanus salvator*).

The leopard cat (*Prionailurus bengalensis*) is a small carnivore (3-5 kg) that is widespread in Southeast Asia. It occupies a wide range of habitats, including human-modified areas of shifting cultivation, logged forest, rubber and oil palm plantation (Payne *et al*., 1985; Sunquist & Sunquist, 2002; Francis, 2008). The leopard cat has an orange to yellowish coat with black spots (that vary from small and round to large and irregular), and a medium-length tail (Francis, 2008). Usually nocturnal, it is mainly terrestrial, but can climb trees and swim well. In our study, the leopard cat was found at all camera-trap locations in both Libo and Rama-Rama estates (Table 2 and 3), showing that it occurs throughout oil palm plantations. However, the occupancy of leopard cat near protected forest and conservation areas was higher than in other sites (Table 4). These preliminary findings suggest that although leopard cats use oil palm plantation for hunting rodents, protected forest and conservation areas might also be important for this species (possibly for providing daytime rest sites). A study by Rajaratnam *et al.* (2007)

found that the leopard cat preferred oil palm plantation to selective-logged dipterocarp forest for hunting due to the easier catchability of rodents in the oil palm plantation.

The common palm civet (*Paradoxurus hermaphroditus)* is a small carnivore weighing 2-5 kg (Jennings & Veron, 2009), with a black facial mask, pointed muzzle, a long body with sometimes three distinct black or dark brown longitudinal stripes on its back and dark spots on its flanks, short legs, and a long tail (Jennings & Veron, 2009). It is solitary, nocturnal and mostly arboreal (Payne *et al.,* 1985; Halle & Stenseth, 2000), and seems to adapt well to disturbed environments such as acacia and oil palm plantations (Scott and Gemita, 2004; Belden *et al*., 2007; Maddox *et al*., 2007). The common palm civet was found in all four camera-trap locations in Libo estate, but was absent at two of the four camera-trap locations in Rama-Rama estate. However, being mainly arboreal, this species might be under-recorded by camera-traps.

The Malay civet (*Viverra tangalunga*) is found on Borneo, Peninsular Malaysia, the Philippines, Singapore, Sumatra, Sulawesi, and several other Indonesian islands (Jennings & Veron, 2011). It has a greyish pelage covered with numerous black spots, conspicuous black and white bands on the throat and sides of the neck, and weighs between 3 and 7 kg (Jennings and Veron, 2009). The Malay civet is solitary, omnivorous and primarily terrestrial, and mainly occurs in lowland evergreen forest, but also occasionally in degraded forest, plantations, and evergreen scrub (Jennings and Veron, 2011). Although usually regarded as nocturnal (e.g., Payne *et al*., 1985), it is perhaps mostly crepuscular (Colon, 2002, Azlan, 2005), and can have some significant daytime activity (Jennings *et al*., 2006). The Malay civet was only found in Rama-Rama estate and so far, has not been recorded in Libo estate (Table 2 and 3). In Rama-Rama estate, a forest reserve is still present, adjacent to the plantation, where suitable habitat might persist for this species. Jennings and Veron (2009) found that although Malay civets were sometimes found in plantations, they did not seem to venture far from forested habitat (Jennings *et al.,* 2010). Further data from the continuation of our study may reveal the use of oil palm plantations by this species.

The monitor lizard (*Varanus salvator*) is a large lizard that lives along riverine habitats. Its activity is focused around rivers, swamps and the coasts where they feed on large arthropods, small vertebrates and reptiles. Monitor lizards are strictly diurnal, though they may rest for longer than a single night after a large feed. They have no fidelity to any particular location, spending the night in the closest available shelter. They are not territorial, but there is sometimes considerable intra-specific competition around a carcass (Vogel, 1979). The monitor lizard was

found in both Libo and Rama-Rama estates (Table 2 and 3), but was more frequently recorded near the conservation area (Table 4). The conservation area in Libo estate was created in a lowland swamp area and this might provide suitable habitat for the monitor lizard.

Table 3. Comparison of occupancy of small carnivores and monitor lizard in Libo and Rama-Rama estates.

Species	Occupancy	
	Libo	Rama-Rama
Leopard cat	0.36	0.29
Common palm civet	0.13	0.02
Malay civet	0.00	0.01
Monitor lizard	0.12	0.01

Occupancy of each species was calculated using PRESENCE 4.1 software.

Table 4. Occupancy of small carnivores and monitor lizard at each camera-trap location.

Location	Small Carnivores			Monitor Lizard
	LC	PC	MC	
Near forest	0.41	0.01	0.01	0.01
Near conservation area	0.44	0.16	0.00	0.11
Centre of oil palm estate	0.16	0.03	0.01	0.01
Near settlement	0.18	0.06	0.00	0.00

The occupancy of each species was calculated using PRESENCE 4.1 software. LC = Leopard Cat (*Prionailurus bengalensis*); PC = Common Palm Civet (*Paradoxurus hermaphroditus*); MC = Malay Civet (*Viverra tangalunga*); ML= Monitor Lizard (*Varanus salvator*).

Lim (1999) reported that monitor lizards were commonly found in oil palm estates, where they could play a significant role in the overall biocontrol of rats, as a captive monitor lizard took about 10 rats within a week (Chung, 2000). Leopard cats also prey on rodents, which can constitute up to 93% of their diet (Rajaratnam *et al.,* 2007). Although the common palm civet is mainly frugivorous (Nakashima *et al.*, 2010), it also consumes small vertebrates and

invertebrates (Fung, 2011). The Malay civet eats fruit, vertebrates (including rodents), and invertebrates (Colon 1999).

In general, small carnivores were photographed as early as 18:00 – 19:00h (when they start to hunt and search for food) until 06:00 – 07:00h (when they return to their daytime rest site) (Fig. 1).

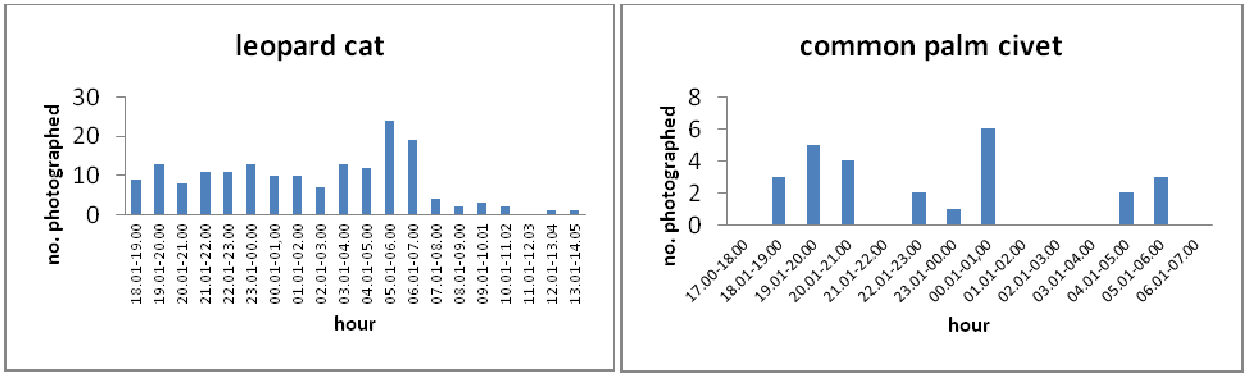

Figure 1. Number of photographed of Leopard Cat and Common Palm Civet in oil palm plantation

Rat damage in both estates remains below 5%, a value considered as economic threshold for five years (2008 – 2012) (Fig. 2). Occasionally, rat damage increases and exceeds 5%, but no rodenticide baiting is done, and rat damage decreases in the next census.

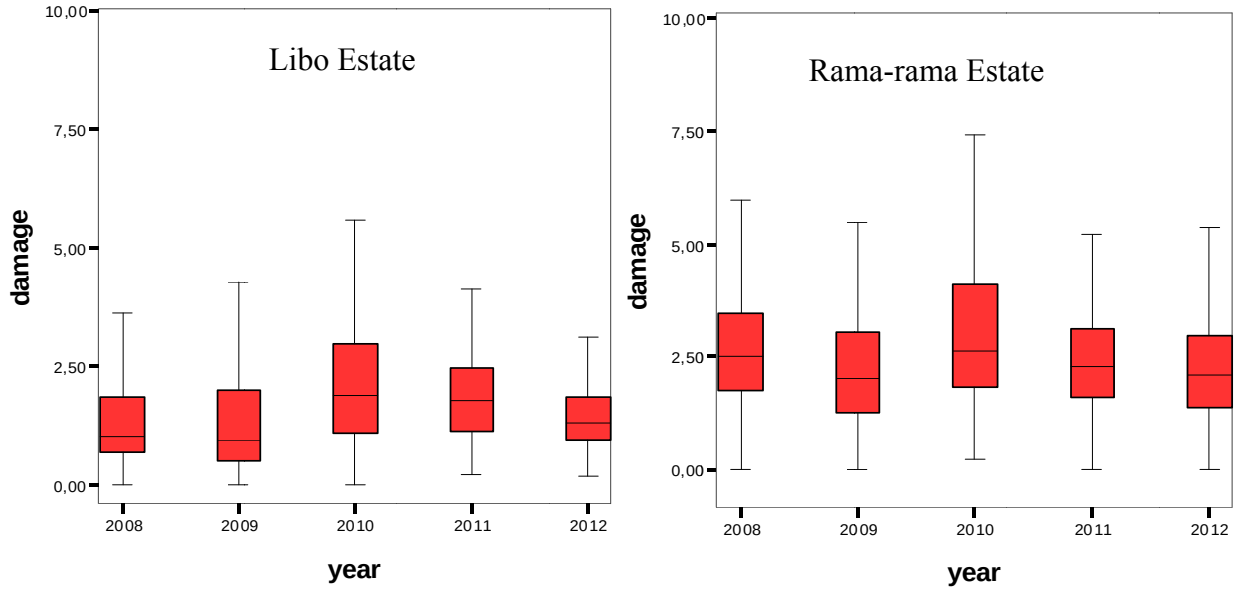

Figure 2. Mean Rat damage in Libo and Rama-rama estates for last five years (2008-2012)

CONCLUSION

This study shows the great potential for using camera-traps to determine the presence and distribution of rat predators in oil palm plantations. Our preliminary results showed a higher occupancy of the leopard cat, common palm civet and monitor lizard in Libo estate than Rama-Rama estate; the Malay civet has so far only been recorded in Rama-Rama. Our preliminary analyses suggest that conservation and forest areas may play an important role for small carnivores and other rat predators. This study is being continued with 10 additional camera-traps, and the final results and analyses will be published.

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